

Guidelines for Barrett Honors College students in the School of Molecular Sciences

The School of Molecular Sciences (SMS) at ASU is a diverse school consisting of scholars from a wide range of scientific backgrounds. Students and researchers at all levels participate in a wide range of educational and research activities to address critical scientific problems in areas ranging from development of new pharmaceutical agents to new green energy technologies to understanding the fundamental processes of photosynthesis. Furthermore, students are challenged to master subject matter and skills that will benefit them throughout their careers. In addition to subject knowledge, students completing undergraduate degrees in chemistry, biochemistry, or molecular sciences can expect to receive substantial training in a number of transferable skills, including data acquisition and analysis, use of computing and information technology, presenting verbal and written reports, and evaluating the work of others.

It may be obvious that many people who study chemistry or biochemistry go into careers in research, but there are many areas in which chemists and molecular scientists work:

- all areas of industry, especially energy, pharmaceuticals, as well as new and specialized industries (e.g. green technology, nanotechnology)
- medicine
- forensics
- patent agencies
- research in government, industry, university and private institutions
- all levels of teaching
- museums
- scientific journalism
- science policy and funding

An undergraduate degree in (bio)chemistry and molecular sciences provides a firm foundation for an application to graduate schools in those areas, as well as professional programs in medicine, dentistry, pharmacy, forensics, life and environmental sciences. To fit the broad range of interests of the ASU student population, SMS offers 8 distinct degrees (<https://sms.asu.edu/degrees/undergrad>):

Bachelor of Science (BS) in

- Chemistry (*Certified by the American Chemical Society*)
- Chemistry with an emphasis on Environmental Chemistry
- Biochemistry
- Biochemistry with an emphasis on Medicinal Chemistry
- Integrated Bachelor of Science/Master of Science (BS/MS) in Biochemistry with an emphasis on medicinal chemistry

Bachelor of Arts (BA) in

- Chemistry
- Biochemistry
- Secondary Education in Chemistry

Guidelines for students in SMS and Barrett

The school has four professional, undergraduate advisors who are happy to help with a variety of questions (<https://sms.asu.edu/student-life/undergraduate-experience/academic-advising>), especially regarding registration, course requirements or selection of a particular degree program. You are encouraged to consult with them early and often throughout your undergraduate students. They can be reached at smsadvising@asu.edu.

Additionally, there are four SMS Faculty Honors Advisors (FHAs) for Barrett:

Prof. Kevin Redding (Kevin.Redding@asu.edu) – lead FHA, biochemist

Prof. Alexandra Ros (Alexandra.Ros@asu.edu) – chemist

Prof. Wade Van Horn (wade.van.horn@asu.edu) – biochemist

Prof. Scott Sayres (Scott.Sayres@asu.edu) – chemist

You are *strongly encouraged* to make an appointment to talk with one of them or attend a workshop about research opportunities in SMS before the end of your sophomore year.

Finally, **Prof. Chad Borges** (chad.borges@asu.edu) is the Associate Director of Undergraduate Programs for SMS. He approves all student enrollment in CHM/BCH 392, 492 and 493 which are the courses that undergraduates enroll in to gain research credit and/or complete their Barrett Honors Thesis. He also enters all student grades for these courses after collecting them from your primary research advisor.

Honors Contracts

Most courses in Chemistry and Biochemistry can be taken for Honors credit; contact your instructor as soon as possible at the beginning of the semester to arrange honors credit for a course. Assignments may include a number of activities such as attending research seminars, reading primary chemical research literature, preparing activities for a class, writing papers, or making a presentation.

Completion of an honors contract is an excellent opportunity to:

- (1) Undertake preliminary reading in an area in which you may wish to complete your thesis,
- (2) Develop a closer relationship with faculty members who may serve as your thesis advisor or referees for graduate or professional school applications.

When planning commitments, bear in mind that inability to complete an honors contract due to poor time management reflects badly on you and may strain your relationships with faculty members. (Faculty members are well aware of the practice of some Barrett Students who “shop around” for contracts, starting several and then cancelling the harder ones along the way. This does not earn anyone a good reputation.)

Study Abroad

Study abroad, like an honors thesis, can be an important, transformational experience. In light of the fact that chemistry/ biochemistry degrees are fairly rigid in the order in which courses must be undertaken (i.e. B builds on A so that A is a prerequisite), completing a chemistry/biochemistry degree and simultaneously studying abroad requires careful planning. Especially in the case that you will study in a language in which you have limited (but growing) proficiency, you may not want to take advanced scientific coursework during

a study abroad experience. Summer can be an excellent time to undertake a study abroad experience, but bear in mind that summer (especially after the junior year) is also a traditional time to complete research projects for a thesis. It is possible to undertake research opportunities abroad, and many opportunities can be found on the website of the American Chemical Society. In short, it is possible to complete a chemistry/biochemistry degree and study abroad, but it requires planning. If you know you are interested in doing this, you should talk with your advisor and/or faculty mentors as soon as possible.

Honors Theses/ Chemistry Research Projects

Barrett students are required to complete an Honors Thesis/Creative Project. SMS students should enroll for 3 credits of CHM/BCH492 (Honors Thesis Research) in the semester before they plan to defend their thesis. In the following semester, they should take CHM/BCH493 (Honors Thesis) for their thesis defense. Note that the 493 course is not repeatable for credit. Please submit your Thesis Prospectus to Prof. Borges when you register for 492 to ensure that your thesis topic is appropriate for SMS and that your committee is properly constituted (see details below).

It is expected that in most cases a student will have started their research project before taking CHM/BCH492. Students can take research for credit as CHM/BCH392 in that case. Remember that students taking research for credit will be expected to spend at least 3 hours per week in the lab on average for each credit hour received. Most people will take research for 3 credits each semester and work at least 9 hours (on average) per week on their project.

Students may choose any area of interest to complete their project. For credit in CHM/BCH 492/493, the student must (1) be a chemistry or biochemistry major, and (2) be engaged in a thesis project with substantial (bio)chemistry content. It is not necessary that the project be undertaken in the laboratory of an SMS faculty member. (Majors doing research in other areas can always get credit in HON 492/493.) All chemistry and biochemistry students are encouraged to consider the opportunities within SMS and elsewhere at ASU, as well as in the Phoenix area or at other research institutions.

Tips for undertaking research in chemistry/ biochemistry at ASU can be found at: <https://sms.asu.edu/student-life/undergraduate-experience/undergrad-research-opportunities>.

The American Chemical Society provides exceptional guidance for the advantages and challenges of undergraduate research in chemistry as well as tips for selecting a supervisor on their website. There are books on the topic as well. (*Getting In* by Oppenheimer and Grey is an excellent book published in 2015 and available on Amazon in softcover.)

Guidelines for membership of your Thesis Committee: The Director must be an ASU faculty member (per Barrett's rules) and preferably a member of SMS. Although Barrett specifies a minimum of 2 thesis committee members, *SMS requires all majors to have 3 members on their committee*. The Director and Second Committee Member are required to be ASU tenure-track faculty. At least one member of the committee must be a faculty member of SMS. The Third Committee Member must have a PhD and does not have to be a faculty member but cannot be a subordinate of either of the other two members (e.g. postdoctoral fellow or research professor in the same research group). For a student doing research with a mentor who is not an ASU faculty member (e.g. at TGen, Barrow, VA Hospital), the research mentor would have to be the Third Committee Member and the

student would have to recruit from among the ASU faculty (preferably in SMS) a Director who is nominally in charge of the thesis.

Timeline of Your Thesis Project

It is important to remember that a worthwhile research/thesis experience does not happen overnight. The following offers some milestones towards staying on track for a successful research experience. In general, just remember that the earlier you get started the more opportunities you have to be successful.

Fall/Spring Year 2: Approximately 3-6 months before you would like to start your research, identify faculty members in your area of research interest and contact them about possible opportunities. Make clear that you are motivated, interested in completing thesis research, and interested specifically in their research. Indicating that you have done your homework and know something of the area they work in will be a major plus. Do not be afraid to contact a faculty member working in an area in which you have not yet had formal coursework. SMS faculty members are aware that most students do not get exposed to some more specialized areas until late in their studies, but are often willing to take on a student early in their college career if there is a good chance that they will remain in the lab for a significant duration of time and make some major accomplishments. If you are interested in a particular research area, just go for it. You should also be aware that faculty members do *not* expect you to come to them with a full-blown project, just a genuine interest in the area in which they work. It is largely assumed that you and your research mentor will develop a project together, and that it will be related to the ongoing research within that laboratory.

Good sources of information about opportunities include ASU websites (Chemistry and Biochemistry, SOLS, Physics, SESE, Biodesign, etc.) and research centers in the Phoenix area (T-Gen, Mayo clinic, Barrow Neurological, etc.). *Remember that research supervisors receive many inquiries.* You will have to stand out to be successful. You should also keep in mind that the beginning of the fall semester and the end of the spring semester are popular times to look for research experiences. The competition in these times will be fierce, since most labs cannot absorb a large number of researchers simultaneously. You are advised to contact several faculty members, not just one.

If you do not receive a response to an e-mail within a week or so, consider stopping by for posted office hours or try a second e-mail or calling a few days later. Many faculty members travel extensively and a response time of minutes should not be expected. Persistence often pays off. (Most research advisors are less interested in people who are easily discouraged. Research is hard and researchers have to deal with lots of failures and setbacks. Those who are easily discouraged will not do well.)

Please keep in mind that, in general, you cannot receive class credit for undergraduate research if you are being paid to perform this research.

After starting your project (Year 3): Meet regularly with your mentor to discuss progress. Make sure that you understand the goals and methods of the project and are not just completing assigned tasks. As you have more research experience, let your mentor know what aspects of the work you enjoy and which you find less rewarding, so that the project can be defined to meet your intellectual goals as well as your supervisor's.

Guidelines for students in SMS and Barrett

At the end of the year before you plan to defend your thesis, you will need to submit a Thesis Prospectus to Barrett. This is a short document helping Barrett see that you are on track to finish your thesis. It identifies the project you plan to perform as well as your Director and the two other committee members. In the past these have been due in September of the senior year, but Barrett is now transitioning to these being due in April of the second semester of the junior year (i.e. a year before the defense would occur). SMS strongly encourages students to submit on the earlier date, as you should have begun your project before that point and there is no reason not to do it.

It is unwise to wait until year 4 to begin a thesis project for several reasons:

(1) **Research takes time:** An academic year is really only ~8 months, and your time will be divided between your research and your coursework. If you graduate in the spring, you will have to defend in April at the latest, which means that you will have to stop your research by the end of February to have time to write up your thesis. If you just started your project in September, you will have very little time to perform and finish a project.

(2) **Letters of recommendation:** If you are applying for graduate/professional programs in your senior year, your research advisor will be an excellent resource both for helping with identifying programs and providing an invaluable reference letter. (In many ways, their letter will be the most important one, and the admission committees will pay it careful attention.) If you have not yet found a supervisor or do not yet really know them, then they cannot write a very strong letter for you.

Autumn of Year 4: Begin to organize and write your thesis, as you continue your research. Writing, like research, always takes longer than you think. In particular, as this is your first long piece of scientific writing, you will face new challenges. Organizing material for your thesis also helps to identify incomplete experiments that should be undertaken to complete the project.

Spring of Year 4: Organize your defense. Your advisor, a second faculty member, and a third researcher will participate in your defense. Scheduling can sometime be tricky so please do this well enough in advance. Remember also that Barrett has funds available on a competitive basis to bring third readers from outside ASU/Phoenix. The deadline to apply for these funds is one semester before your defense. Finally, your committee will need at least a week to review your thesis before your defense. Throughout the semester of your defense, you should work closely with your advisor to assure that your thesis is satisfactory. You do not want any surprises on defense day.